

# Positions Of The Halo Installations and Status of the Network

An interesting problem with the Halo Network, a series of seven ring-shaped structures designed to rid the Galaxy of sentient life, is the manner in which these seven rings would have to be placed to eliminate all life in the Milk Way galaxy. The intent of this document is to examine the problems involved with covering the entire area of the galaxy with seven 25,000 lightyear pulses, and what that information can tell us about the nature of the Halo Network, the location of the seven rings, and the implications for the Galaxy given the destruction of Halo Installation 04.

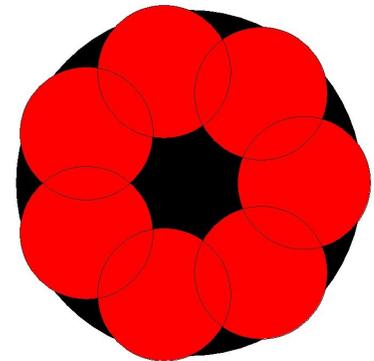
## Assumptions

From *Halo:Combat Evolved*, we discover that the effective range of Installation 04 is 25,000 lightyears<sup>1</sup>. For the purposes of this discussion, we'll assume that all Halo installations have similar ranges. We'll also assume that the Galaxy hasn't significantly changed its structure since the 21<sup>st</sup> Century, and is a barred spiral galaxy roughly 130,000 lightyears across<sup>2</sup>, all of which must be purged. We'll also assume that each Halo installation destroys all life in a sphere with a 25,000 lightyear radius.

## Models

To examine the coverage of the Galaxy provided by the Halo Network, we'll need to construct a model of the Galaxy on which to test different configurations. For the purposes of simplicity, the model will be two-dimensional. Since the Galaxy is significantly smaller on its axial dimension than it is on its other two, this is a reasonable, although ultimately flawed assumption. Extension of this model to three dimensions is left to a later analyst.

This model, simply put, will be seven circles of 25,000 lightyears set over a circle of 65,000 lightyears. The effectiveness of a given configuration of circles will be indicated by what percentage of the 65,000 lightyear "Galaxy Circle" is covered by the 25,000 "Halo Circles".



*Figure 1: The Evenly Spaced Halo Model, covering approximately 84% of the Galaxy.*

### ***The Evenly Spaced Model***

It seems obvious to start with the idea of the seven installations being evenly spaced around the galactic circle (Figure 1). If we divide the Galaxy into seven equal slices, and place an installation in the center of each slice, we find that by placing each installation some 43,000 lightyears from the galactic core, we can achieve 84% coverage of the Milky Way. While 84% is certainly an admirable kill percentage in any attempt to

<sup>1</sup> 343 Guilty Spark in Two Betrayals, "Technically, this installation's pulse has a maximum effective radius of twenty-five thousand light years."

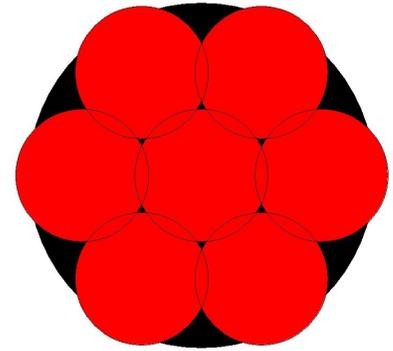
<sup>2</sup> Wikipedia, Milky Way, [http://en.wikipedia.org/wiki/Milky\\_Way\\_\(galaxy\)](http://en.wikipedia.org/wiki/Milky_Way_(galaxy))

genocide all life in a galaxy, it does not solve the problem of the Flood being able to find sentient life in the 16% of the surviving Galaxy.

If we postulate that the Halo Network is supposed to have 100% effectiveness in ridding the Galaxy of potential Flood hosts, it does not appear that the Evenly Spaced model will work as a deployment scheme. It is also worth noting that since the galactic core is denser than the arms, the 16% missed by this model would contain a disproportionate number of stars.

### **The Hub and Spokes Model**

The next possible model for covering the Galaxy is placing one ring in the center of the Galaxy and having each of the other six evenly space around the the galaxy(Figure 2). If we choose to pursue this concept, we find that by placing the six outer installations in a circle 45,000 lightyears out from the core we can achieve over 91% coverage of the galactic area. This model is obviously superior in terms of galactic coverage, but the astute observer will note that at optimal coverage, small holes appear on the rim of the central ring's range, meaning that some sectors on the galactic interior wouldn't be cleansed by this method.



*Figure 2: The Hub and Spokes Model, achieving 91% coverage.*

If we retract the rings back to 43,000 lightyears, our coverage drops by two percent, but eliminates the holes in the blanket caused by having the rings at 45,000 lightyears.

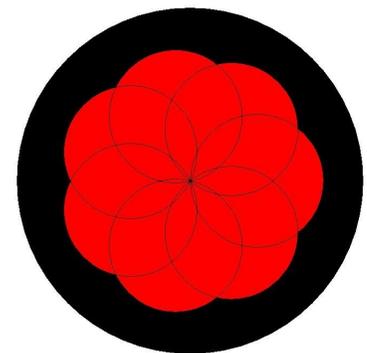
### **Boundaries**

With the Hub and Spokes model, we find the fundamental problem with trying to undertake this exercise; the further in we are, the less of the rim we get, the further out we are, the less of the core we get. So lets look at at the limits of what we can do. First we'll examine the largest area we can get without losing any central area, then we'll look at if we can cover the rim.

### **The Core**

If we contract a version of the Evenly Space model in far enough (Figure 3), we find we can achieve nearly 55% galactic coverage, and not leave any space in the core untouched<sup>3</sup>. This coverage percentage is obviously a terrible performance for a deployment pattern.

Alternatively, we can adjust the Hub and Spokes model as discussed above to produce approximately 89% coverage and still cover the whole of the galactic core, as one of the rings is dedicated to sitting in the very center of the Galaxy.

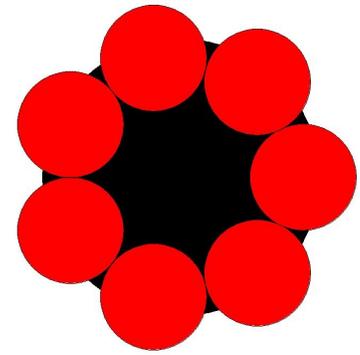


*Figure 3: The Evenly Space model calibrated to provide maximum core coverage.*

<sup>3</sup> The core is actually missed almost entirely by this model if the basis is extended to 3 dimensions.

## The Rim

The rim of the Galaxy poses a more difficult problem. If we were to attempt to just cover the galactic perimeter with our rings, we certainly wouldn't be using Hub and Spoke. We'd want to move all of our rings out in a circle, meaning Evenly Spaced would be the model of choice for deployment. If we try to cover the entire rim, though, we find that at 57,500 lightyears from the center of the Galaxy, our Halo ranges no longer touch each other, and from that point on we'll begin to get gaps in our coverage of the rim (Figure 4). From this experiment, we can conclude that there is no practical way, given our assumptions about the nature and capabilities of the Halo Network, for the system to reach all of the stars on the rim of the Galaxy.



*Figure 4: The Evenly Spaced model with a radius of 57,500 lightyears.*

## Locations of the Remaining Rings

It seems clear that the Halo Network is not up to the task for which it was designed, but perhaps the Forerunner knew more about the distribution of sentient life in the Galaxy than we do. Let us presume that the Forerunner knew that all life worth extinguishing would be located within approximately 55,000 lightyears of the center of the Galaxy. In this case, the closed Hub and Spoke model would capture approximately 89% of the Galaxy in its blast, and those planets spared would be more than 55,000 lightyears from the Core, where stars are far apart on the galactic rim. What does that tell us about the locations of the remaining installations?

### ***Installations 04 and 05***

Given that Installations 04 and 05 were within easy jumping distance of the Covenant from Terra, we can presume that they were consecutive spokes in the Galaxy (their numbering would seem to confirm this assessment). The two installations would be approximately 44,500 lightyears from each other, and 43,000 lightyears from the installation in the core. If we assume that Earth is almost exactly between these installations (even by the most liberal estimate, Sol only orbits the Galaxy at 27,270 or so lightyears), it means that Earth is over 28,140 lightyears from at least one of the Halos!

## Effects of the Loss of Installation 04

The loss of Installation 04 was a devastating blow to the the Halo Network. The coverage of the Galaxy dropped from 89% to 78%. Unfortunately for Humanity, if Earth was indeed between 04 and 05, it will still be within 05's blast radius<sup>4</sup>.

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<sup>4</sup> If Earth isn't in Installation 05's blast radius, then Regret's flagship jumped over 25,000 lightyears in one go from Sol.

## Conclusions

Given the assumed capabilities of the Halo Network, we can derive a number of interesting bits of trivia. These conclusions are based on calculation of galactic coverage and statements from the game, as represented above.

First, the Halo Network can't purge the entire Galaxy with 7 25,000 lightyear pulses. Under optimal circumstances, it could only purge 91% of the Galaxy, and it seems more likely that it would purge 89%. This indicates that either the Halo Network has some capability that has not yet been described, such as rings having inconsistent effective ranges, or possibly that a large portion of the Galaxy, such as the Rim, is incapable of supporting life.

Secondly, if the Halo Network once worked, it doesn't anymore. Unless Installation 04 was redundant with another ring, a large portion of the Galaxy will no longer be affected by a Halo firing. Given that the point of this exercise is to exterminate all life capable of supporting the Flood, an opponent who can obviously build back from a quite diminished state, there no longer appears to be any reason to fire the Halo Network.

Finally, the distance between the installations raises some very disturbing questions regarding the Covenant's hyperspace capabilities. The Arbiter is able to travel from Installation 04 to High Charity to be punished for treason, become the Arbiter, and still make it to Installation 05, 44,500 lightyears away, literally a third of the diameter of the Galaxy, in apparently just a few months. Certainly, the Covenant could span the entire Galaxy with its empire, meaning that even if Humanity does manage to foil the Covenant drive on the Ark, the Covenant could discover and find a way to fire Installations 07 or 02, and Humanity would have no good means of stopping them.